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Falmouth*

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1212*



# MINERS' ASSOCIATION

*Box I,*

OF

97. E. CORNWALL AND DEVONSHIRE.

*Box 0090*

J. F. BASSET, ESQ., PRESIDENT.

THE ANNUAL MEETING

HELD AT FALMOUTH,

SEPTEMBER 8, 1864.

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ROBERT HUNT, ESQ., F.R.S., KEEPER OF MINING RECORDS,

HON. GENERAL SECRETARY.

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A Meeting will be held at the Town Hall, on Thursday Evening next, October the 13th, at half-past Seven o'clock, to which artisans, working men, young men, and others, are particularly invited, for the purpose of conferring with Mr. J. C. BUCKMASTER, of the Science and Art Department, and making such arrangements as may be thought desirable for the formation of a Class or Classes in Elementary Science, in accordance with the scheme explained by Mr. BUCKMASTER at the Assembly Room on Thursday evening last.

C. BARHAM, M.D.,

*Vice-President of the Royal Institution of Cornwall.*

R. TWEEDY,

*President of the Truro Institution.*

Truro, October 8th, 1864.

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THE ANNUAL MEETING  
OF THE  
**MINERS' ASSOCIATION**  
OF  
CORNWALL AND DEVON,

*Held at FALMOUTH, on THURSDAY, September 8, 1864.*

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The annual meeting of the members of the Miners' Association of Cornwall and Devon was held in the Committee-room of the Polytechnic Society, on Thursday afternoon, the 8th instant. The attendance was very numerous, the following being among the company present :—Mr. J. J. Rogers, M.P. (in the chair); Messrs. Robert Hunt, J. S. Enys, R. W. Fox, Alfred Fox, W. M. Grylls, F. Hill, R. H. Pike, W. Angwin, R. Cunnack, Cox, Corfield; Revs. Saltren Rogers, V. Vyvyan, and R. Tudor; Captains Tonkin, Williams, Quintrall, Taylor, Burgen, Chapple, Tregoning, Tredinnick, Phillips, and others, with many ladies.

The CHAIRMAN said he had been asked to take the chair at this meeting, and although he felt great interest in the objects of the Mining Association, he, with great diffidence, consented to occupy that position, and he very much wished that some one more competent than himself—and there were several in the room—could have been prevailed upon to fill the place. He felt, however, that the subject would require very little to be said by himself, because he was happy to say that the agenda paper contained several subjects which were to be brought before the meeting, and which would more interest them than anything he could say in the way of general remarks. He would allude, however, rather briefly, to a circumstance that came under his notice recently in connection with the Miners' Association at Helston. About a fortnight ago, Mr. Buckmaster, whose name was well known by persons who had entered upon the study of

chemical science as having been connected for some years with the Government Department of Science and Art, at South Kensington, London—probably owing to a suggestion which was thrown out by those who felt an interest in the Miners' Association —(hear, hear)—and he believed, at the suggestion of those who superintended the Department of Science and Art, consented to visit Helston for the purpose of giving a lecture upon the objects of the Government Department with regard to the establishment of local classes. It was well known, he believed, that, as far as the subject of art was concerned, there had been no difficulty in establishing schools at very many places—not only in places of first-class importance, but even in second-rate and third-rate towns throughout the United Kingdom ; and they had had opportunities of seeing from year to year at the Polytechnic exhibition the results of those schools within the county, and in which the county was much interested. They had this year some very nice drawings sent from the School of Art at Penzance, and they had had some from the Truro school also. (Hear, hear.) But it had been found by the Department of Science and Art that, with regard to the other branch of knowledge, in which they particularly desired to be conversant, the practice had been very much slower. That was not to be wondered at, because, of course, the subject of Art was much more generally attractive than that of Science, but it was felt that in this county great advantages might be expected to flow from a wider cultivation and spread of that branch of knowledge, and that it might be useful to see whether an effort could not be made in that direction, in order to induce classes to be established. Mr. Buckmaster, instead of giving a lecture, confined himself on the occasion of his visit to Helston to the plan adopted by the Government Department with regard to scientific study. Without wearying the meeting by going into the details, he might give a short sketch of the plan. As it was found to be very expensive to send down lecturers into every locality where there was any prospect of scientific classes being established, they wished to stimulate familiarity with the subject of science in the different localities, by means of certificates offered to pupils who could show a sufficient amount of progress, to entitle them to offer themselves as instructors, and thus to gradually obtain a competent staff of instructors in different localities—as, for instance, at Helston and other places in Cornwall. An examination would be conducted by the Department, and those who succeeded in passing the examination satisfactorily would receive a certificate which would enable them to become teachers. It was intended that these instructors should endeavour to get around them groups of students who should compete with one another for prizes. Of course, the Department of Science and Art did not care so much to stimulate those branches of science with which the Miners' Association dealt as to promote the study of science generally. It appeared to him that at the

present meeting they might, perhaps, consider whether they could not usefully engraft upon the local branches of the Miners' Association some such plan as that sketched out by Mr. Buckmaster in his lecture, and endeavour to stimulate the study of science in the direction which was chiefly available for assisting the objects of the Miners' Association. Farther than that they had not yet arrived. Mr. Buckmaster contented himself with endeavouring to sketch lightly the plan which he (the speaker) had just indicated. At Helston, for instance, in the course of the past spring, examination papers were sent down for the purpose of enabling students to be examined under them, and several students who were more or less connected with the Miners' Association tendered themselves for examination. The examination papers were sent back to South Kensington and submitted to the professors, and out of the number examined, two received third-class prizes for chemistry, and two others were honourably mentioned. That seemed to be a very fair beginning in a locality which, at present, was not a very important focus of mining enterprise, but which those who lived in the locality looked forward to being, by and bye, one of the most important centres of mining enterprise in Cornwall. (Hear, hear.) However, after that small beginning it might be hoped that some important results might be obtained. (Hear.) He merely referred to this, not by way of suggestion that any pledge should be given by this meeting—or by the Miners' Association—to carry out this plan, but because he thought it was quite worthy of consideration at the hands of the Association, and he should be very glad to hear what the opinions of the leading members of the Association were upon the subject. He thought, perhaps, that it would be best that he should not weary the meeting by going into the general objects of the Association. These had been very fully laid before the members and before the county by means of the reports of the Association, which were distributed from time to time; and he thought he should most conduce to the objects which they wished to obtain by calling upon those gentlemen who had reports to deliver to read them. Mr. Robert Hunt had informed him that he had the names of those who had passed the examination successfully, and he would ask him to read them. (Applause.)

Mr. HUNT said, that seeing the system of examination had been described by Mr. Rogers, it was only necessary for him to name the successful students who had passed their examinations this year, and he might say that a much larger number would have appeared on the list if they had been enabled to conform to the rules of the Department of Science and Art, one of their rules being that every student should have attended 40 lectures. Owing to the arrangement which had been made by the Miners' Association, with a view to extend their operations over as large a field as possible, it became impossible, in a great many instances, to give the students the required number of lectures previous to the examination. He hoped,

however, by the arrangements they would make, that next year they should be able to afford the opportunity of examination to a far larger number of young men, and the consequent honours dependent upon them. He merely mentioned this for the purpose of explaining how it was that out of the several classes they had had at work there were so few who passed their examination. By far the largest number of those who presented themselves for examination this year had passed, and that most creditably. The following was the list of the successful competitors :—

**MINERALOGY.**

Samuel Bawden, St. Day.  
Thomas Corfield, St. Day.  
William Bawden, St. Day.  
Joseph Blight, St. Day.

Henry Cock, Gunnislake.  
Samuel Langdon, Gunnislake.  
Thomas Richards, Gunnislake.

**CHEMISTRY.**

Thomas Quintrall, Helston.  
John Rowe, Helston.  
Andrew Adams, Helston.  
Thomas Downing, Helston.

George Richards, Gunnislake.  
Samuel Langdon, Gunnislake.  
Thomas Richards, Gunnislake.  
Henry Cock, Gunnislake.

He could not avoid mentioning another matter which also rendered their list comparatively small. It was this. The examination papers as they were drawn out by the professors in London to be circulated not merely amongst the classes of that county, but to all the science classes in the United Kingdom, had of course no especial reference to mining. The examination papers on mineralogy consequently dealt with branches which did not really concern the working miner. Upon that list was found a large number of questions on crystallography which their excellent teacher, Mr. Pearce, had not thought it advisable at the present stage of their proceedings to perplex the young mind with. Consequently there were upon those examination papers a great number of questions for which a young man in Cornwall could not be expected to provide answers. Hence, seeing they were required to answer twelve questions in each list, there were several of that character which it was impossible they could answer, and indeed it did appear to him unnecessary that they should be troubled with them. He might mention with regard to the visit of Mr. Buckmaster, that that gentleman had been sent down by the Department of Science to see whether there was a disposition to form classes for scientific instruction, with a view to their establishment. The Department proposed, if possible, to organise a system of local certificated teachers. For example, any young man who had devoted his attention to any particular branch of science—to chemistry, mineralogy, geology, mechanics, or any other branch—could in the month of November offer himself to the Department of Science and Art for examination in those subjects. All his expenses to London were paid by the Department, and certain allowances were granted for the period of his residence in town while undergoing those examinations. Therefore a young

man was put to a very small cost, and he could choose the subject upon which he would be examined. If he passed his examination in that particular subject he became a certificated teacher, and being a certificated teacher, it would then be his interest to endeavour to form around him classes which should receive from him in the course of the year, or previous to the time of examination, the number of forty class lectures, or demonstrations. Then, examination papers were sent down to him, and two or three gentlemen of the neighbourhood acted as a committee to see that the examinations were fairly conducted, and the young men having answered the questions proposed upon those papers, the replies were forwarded to London, and submitted to the professors who had drawn the questions up, and who would decide whether or not they might be considered as having passed, and whether they were worthy of prizes, and if so, what particular kind of prizes should be awarded. Then the certificated teacher, for every one of his pupils who had passed, would receive from the Department a certain sum of money, payment thus being made according to the results obtained. Thus at the present time many gentlemen in various parts of the country were really deriving a considerable sum by merely organising classes of this kind, and succeeding in passing those whom they instructed. Mr. Buckmaster was deputed by the Department to come again into Cornwall in the month of October, when he would stay a fortnight, and visit all the principal towns. The Miners' Association, of course, took no part in the organisation of classes, excepting those which were mining classes established in the mining districts. The members of the Association were much interested in the diffusion of scientific knowledge, and would give what assistance they could in that direction; but they were most anxious to keep their own society an association for miners, and would not have its operations mixed up with the establishment of classes in towns which were apart from the mining district.

Mr. R. PEARCE, the lecturer of the association, then said that during the summer months a number of field excursions had been made by the classes, the attendance at which had been very good. These excursions had proved exceedingly successful during the summer months, in which there was always some difficulty in holding evening meetings. Papers had been prepared by the members of the classes at Helston and St. Day, describing these field excursions.

#### NOTES AND MEMORANDA OF EXCURSIONS,

*Made by the St. Day members of the Miners' Association of Cornwall and Devon.—Teacher—Mr. R. Pearce.*

EXCURSION TO CARMARTHEN, for the purpose of examining the geological and mineralogical features of the granite, &c.

*Quarry on the summit of the hill.*—The principal object of interest discovered here, was a large globular mass of elvanite, about two feet in

diameter, with a coating half inch in thickness, composed principally of massive schorl, but in some places there was also a thin layer of quartz stained with peroxide of iron. Further observed in this quarry several masses of elvanite (or a very fine grained variety of granite) imbedded in the granite of the quarry, and occurring at various depths from the surface. No trace of a regular "elvan course" could be discovered.

The general character of the granite of the hill was primary, or composed simply of quartz, felspar and mica, but where a vein of quartz or veins of other character were discovered, the felspar for 2 or 3 inches on each side of it was of a pinkish color, and it sometimes contained chlorite; where the vein was larger, the granite was altered for a still greater space on each side of it, apparently as if by the influence of the vein of a foreign nature.

This alteration of the granite was more plainly shown at West Wheal Damsel, which mine was also visited on this excursion. Here we found all the granite near the lode to be very much altered, more or less so according to its proximity to, or greater distance from it, the change being greatest near the lode; the felspar was sometimes entirely absent, chlorite occupying its place, sometimes only partially, and that broken at a still greater distance from the lode was merely of a flesh colour.

In all our excursions we have noticed this alteration of the granite by the influence of lodes and veins, and in some cases a still further change from these influences was observed; two examples may be mentioned. At a burrow at Old Wheal Jewell, there are stones of granite to be found where the felspar has been replaced by tin, schorl, &c. (Mr. Pearce has mentioned the same thing as having occurred at Dolcoath). In a cross-cut at East Wheal Damsel, at a distance of 5 or 6 fms. from the lode the granite contained cuprite.

We have in our collection some very good specimens illustrating the above-mentioned change in the granite from the influence of lodes, veins, and mineral deposits.

**EXCURSION COMMENCING AT WHEAL PINK.**—Some time was spent in examining the burrow, which chiefly consisted of granite and attle from the lode—we collected here a few specimens of fluor, copper pyrites, granite, &c., to show the character of the lode and its matrix; the granite was differently constituted from that of the quarries at Carnmarth. Treskerby quarry—granite primary, noticed schorl and chlorite in several of the joints running in a direction nearly east and west, while in those on a bearing approaching north and south no trace of any mineral could be discovered. The same thing was discovered at Carnmarth; in one of the joints there bearing 10 deg. north of east, some crystals of fluor were discovered. At Wheal Pink observed the junction of granite and killas. It was here noticed that the

killas was of a different character from that of mines producing large quantities of copper, being much darker, and containing considerably less alumina.

From Ting-Tang, through part of Clifford Amalgamated. Specimens of elvanite were found at the former mine, in which from disintegration and decomposition, the potash being removed, the felspar was found changed into the form of kaolin or china clay.

Most of our attention was turned this evening to the large elvan-course at the United Mines, which underlies north and runs parallel to, and over the lode ; here we found the lode had exercised precisely the same influence as on the granite ; in some instances it was so much like it that a superficial observer would not suppose it to be elvanite. Specimens were found in which the change seemed still in operation, the transmutation being incomplete ; some of the crystals of felspar (already changed into kaolin), were only partially filled in by chlorite, and others in which there was only a small speck of chlorite in the centre. This elvan course is found to affect the lode very favourably when it is contiguous to it, but when not in actual contact, that is, when both walls are composed of killas, the lode produces considerably less ore.

**EXCURSION FROM ROSE LOBBY.**—Collected specimens of copper pyrites, vitreous copper, black oxide of copper, malleable copper, black and yellow opal, black jasper, &c.

Met with nothing different from what was seen on former excursions until we are ~~at~~ at North Grambler ; here we were very much interested on examining the gossan broken at the 85 fm. level, of which several piles were at the surface ; this gossan is very rich for tin, being worked at a "tribute" of 6s. in the £. Instances are not common of gossan occurring at so great a depth from the surface ; although one instance is known in the Ting-Tang and Clifford Mines, the gossan lode in each being the same, and continuous where it still remains a "gossan lode" at a very far greater depth.

There were two excursions made after this, and many interesting specimens collected, an account of which may be found in the catalogue of the class.

Elvan courses are found often running nearly parallel with lodes, and when forming a junction with them, under certain circumstances, are considered to influence them most favourably in forming deposits of ore. White elvans and those somewhat decomposed are liked best by miners, while a very hard, dark coloured, and compact elvan is not considered at all congenial. The position of the elvan with respect to the lode is by many thought to be also of great significance.

There are two varieties of slate in this district—one hard and of a dark blue slate colour, containing little alumina, is generally considered to be unfavourable for the production of mineral, and may always be found in

"poor mines," in a killas or slate strata. The other, light slate colour, sometimes nearly white—not generally very hard—contains a large proportion of alumina. Copper lodes are generally rich and productive in a killas of this character.

**Cross-courses.**—Their effect on ore-bearing lodes is generally good. If the cross-course is small the lode is usually greatly improved at the intersection. Where the cross-course is large, the lode, if of a kindly appearance before, is almost invariably richer, or rich to within a few fathoms of the intersection. Lodes are heaved by cross-courses a greater or less distance according to the angle of the intersection.

The general direction of lodes in this district is about east and west, but if turned a few degrees south of east by the influence of a cross-course, slide, or by any alteration of the strata, is generally found to be favourably changed.

The Gwennap district is generally most favourable for the production of copper ores. They are found in almost every variety, copper pyrites predominating, although many mines have produced large quantities of black oxide—such as Wheal Jewel—and others red oxide and vitreous copper in large proportions; these are often found associated one with another, especially near the surface and in the gossan. Copper and iron pyrites are nearly always found together—quartz, fluor, and sometimes both, in veins of copper pyrites.

Tin is found in some mines in very large deposits associated with wolfram, arsenical pyrites, mica—sometimes copper pyrites, &c., &c.

Besides the minerals already mentioned, blende is sometimes found in considerable quantities; galena occurs in some mines. Gossan is often found to contain silver. Ores of iron, and other ores of almost every variety, are found occurring in the mines of Gwennap.

We do not pretend at present (our observations being yet too limited to afford sufficient data to form systematic conclusions from them) to offer any opinions on which may be founded any particular "theory." A very much greater accumulation of facts will be requisite for such a purpose, but we hope that these our few observations may be of some service, if followed up by others in a similar direction, in ultimately leading to more certainties for the miners' guide than at present exist.

The paper was illustrated by a large number of specimens which the students had collected, and which were ranged upon the table.

Mr. R. HUNT next read notes of one of three excursions made by the Helston class, but we publish the three.

NOTES ON THE EXCURSIONS OF THE HELSTON BRANCH OF  
THE MINERS' ASSOCIATION OF DEVON AND CORNWALL.

## FIRST EXCURSION.

From the schoolroom at Three Cross, which is about half a mile south of Wendron Church, to the Old Wheal Trumpet Mine. On the refuse heaps of this mine the granite raised from about the lodes exhibits traces of considerable change, which Mr. Pearce explained to be similar to what he had observed in the same kind of rock in all the metalliferous districts of the county; but peculiar in having numerous crystals of iron pyrites interspersed throughout the substance of the rock;—some of the crystals being partially, and others wholly, converted into oxide of iron. In some specimens the crystals had dropped out, leaving corresponding cavities.—The lodes of this district are not generally very large; their bearing is E. and W., with a north underlay. They have been, and are still, very productive of tin; and small quantities of rich vitreous copper have also been raised.

Proceeding west, and crossing the valley of the Loe River, which runs nearly north and south, Wheal Mount Hill was ascended. This hill forms the most southerly spur of the Carnmenellis granite range; and, although steep on the east, south, and west sides, the summit towards the north is a continuation of an irregular plateau, reaching to Crowan Beacon, and thence to the Camborne hills. The hill is traversed by several lodes which have been partially wrought for tin and copper; although wide at the top, they have, at a comparatively shallow depth, diminished to mere traces.—The granite in the refuse heaps exhibits the same peculiarity as that noticed about Wheal Trumpet, except that the crystals of iron pyrites are less thickly disseminated.—Descending the hill, towards the south, the valley of the Loe River (which at this point appears to have been worn through a hard spur of granite projecting from Wheal Mount Hill, of which the Relubbus quarries on the opposite side, and which were next visited by the class, form a continuation), was re-crossed. Previous to the opening of the quarries, the bed of the river and sides of the valley in this place were covered with large blocks and boulders of granite, piled together in masses of the most picturesque character. Except in the bed of the stream, these have been removed by the operations of the quarrymen, which have laid open immense beds of compact building granite, exhibiting, as explained by Mr. Pearce, three sets of remarkably well defined cleavage planes; one of these, bearing east and west, and apparently forming a continuation of one of the metalliferous veins of the adjoining mine, Wheal Trannack. These carried on the sides of the plane some fine crystals of arsenical pyrites and spots of copper ore.—About three hundred fathoms below the granite quarry, the junction of the granite and killas occurs; at this point the valley bends to the west, and numerous dykes of greenstone, crop up above the surface; among them is situated the Old Wheal Trannack Mine, formerly very productive of copper

ore. Operations are now carried on on a north lode, where iron and arsenical pyrites, blende, and vitreous copper are raised. The ores in this mine contain about 10 ozs. of silver to the ton. The greenstone at this point was explained by Mr. Pearce to be, in its general features, similar to that met with in the Camborne and Redruth districts; except that the latter contains garnet in a massive and crystalline form; a mineral not apparent in the former.

#### SECOND EXCURSION.

Proceeded first to Trevenen mine, where the lode, which is in granite, has been one of the most productive ever opened in Cornwall. In the granite about the lode, much of the felspar has been replaced by chlorite, the almost invariable accompaniment of tin ore. The lode is remarkable for being separated from the compact granite on the north by a bed of soft decomposed or "pot granite," which, in the opinion of many agents in the district, is intimately connected with the deposit of the ore in the lode. From its being liable to scale off, it has often occasioned inconvenience. From this point to Wheal Whidden the granite is hard, but of coarse fracture. The latter mine was productive for some distance, but the lodes, as they approached the hard granite in a projecting spur of the Beacon Hill, were bent out of their proper course and became barren. The granite *débris* from this mine remains unaffected by exposure, while that from the adjoining mine, Wheal Walls, on a parallel lode, becomes completely disintegrated. At a short distance south-east of Wheal Whidden, the junction of the granite and killas occurs. One of the south lodes of Trevenen, after its passage into the latter rock, is now being explored in Treworlis estate. Here there is an elvan and a well-defined crosscourse in the flat-rod shaft, which appears to be the continuation of the great cross-course in Wheal Trumpet. The lode west of the crosscourse has yielded good quantities of tin and copper ore, accompanied by abundance of fluor spar, previously of rare occurrence in this district, together with the following minerals—blende, sulphide of lead, carbonate of iron, and iron pyrites. Wolfram has also been met with in the east side of the crosscourse. This mine drains the water for a considerable distance round; a well belonging to a farmhouse, about four hundred fathoms distant, being completely dry since it has been in operation. The killas in the waste heaps is characterised by being full of brown spots about as large as peas, and is said greatly to resemble that met with on the banks of the Tamar, about the Great Devon Consols. Proceeding south, a large dyke of greenstone, running nearly north and south, is seen crossing the road and passing through a field at Craskin. This rock must at some time have existed here in abundance at surface, the hedge stones consisting almost entirely of it; and numerous traces of large dykes are still clearly to be seen at Trelill, and on the road to Helston. The surface formation of the portion of the Wendron district through which these excursions were made seems to be greatly affected by the hard ridge of rock referred to as an exten-

sion of Wheal Mount, and comprising Relubbus quarry, on each side of which it extends, forming the eastern side of the valley in which the Loe river runs. As if barred by the hard rock, the whole of the eastern springs discharge themselves through a series of small valleys (most of them commencing on crosscourses), into the Helford river, on the opposite side of the promontory. On approaching this hard rock the various lodes have become unproductive. In one case, at Wheal Dream, a shaft has been put down through it to reach a shoot of tin that had dipped west from the old Wheal Trumpet mine. The lode here was barren till about the 60 fathom level, where the hard compact granite was penetrated, and the dip of tin ground, carrying a softer channel of rock, was reached. From this point the lode has continued to be productive; the mine being at present 180 fathoms deep. In this case, as at Trevenen, the peculiar character of the ground is considered to be connected with the productiveness of the lode.

#### THIRD EXCURSION.

##### *From Helston to Penrose Lead Mines.*

The clay slate upon which the town of Helston is built, is, towards the south, traversed by a very large elvan-course bearing about north-east and south-west. Its course may be traced for about a mile in length. At two points, extensive quarries have been opened upon it, from which most of the stone of which the town is built has been raised. Minute traces of sulphide of lead have been found in the elvan, and the clayslate about it is traversed by numerous lead veins. On the north and north-west sides of the town numerous patches of greenstone crop up, and about them, in digging wells and foundations for buildings small quantities of iron and copper pyrites have been found. From Helston to Penrose, the road passes down the valley of the Loe river till its junction with the lake, over an alluvial deposit, consisting at the surface, of sand, and at greater depths, of vegetable matter, alternating with gravel, covering, at a depth of about thirty feet, some tin-stream ground. At the head of the lake is the old Wheal Pool lead mine, formerly very rich. The line of the shafts bears nearly north-west and south-east, and the lode is said to be a continuation of a large cross-course traceable as far as Hayle, and seen in the excavation of the turnpike road between Helston and Breage. Passing through the grounds of Penrose Mansion, traces of the proximity of mining operations are evident, until at Higher Penrose farm, the hedges are in great part seen to be composed of stones of elvan and mine refuse; among which lode-stones of massive and crystallised quartz, containing carbonate and oxide of iron, sulphide of lead, and occasionally copper pyrites, are abundant. A little beyond, the extensive workings of Wheal Penrose and Wheal Rose mines are reached, in the old heaps of which, rich and interesting specimens lie thick. In the former mine, now being wrought by Mr. John Hunt, of Porthleven, the rich and delicate looking yellow and grass green crystals of arseniate and

phosphate of lead are most remarkable ; next, the large white needle-shaped fascicles of carbonate of lead, coating the massive blocks of sulphide of lead and quartz. Lately, some fine transparent crystals of sulphate of lead have been discovered by Mr. Hunt, which, adhering to the black velvety surface of haematite ore, have a peculiarly lustrous appearance. On the adjoining mine, Wheal Rose, are large quantities of carbonate of iron, for which, at present, the mine is principally worked above the adit level. In these ores some very clear perfect crystals of quartz were found by members of the class. These mines are said to have been worked from a remote period—as far back indeed as the Roman occupation. In the eighteenth century they were held on lease by the Godolphin family, and have at intervals been exceedingly rich. The lodes run nearly north and south, magnetic, and are parallel to the ridge of the hill in which they are contained. In the cliff below the mines, the clay slate alternates from a blue to an olive green colour ; the former being the productive rock ; the cleavage planes are 35 degs. east of north and north and south, the latter, which are nearly parallel to the lodes, frequently contain veins of massive quartz. About midway between the Loe bar and Porthleven is a lode about 12 feet wide, bearing 20 degs. north of east, and underlying 25 degs. south of east, exhibiting a fine gossan ; and about fifty fathoms further towards Porthleven, the Wheal Penrose lode is also seen. Directly under the workings of Wheal Penrose mine is a large lode running about east and west, from which at low tides, sulphide of lead may be broken ; and, occasionally, on the beach rounded pebbles of massive carbonate of lead have been picked up—some of these are still in the possession of Mr. John Hunt. The whole of the rocks in this vicinity contain lead veins, and it is not improbable that it may again resume its place as the greatest lead-producing district of Cornwall.

Mr. HUNT observed that it would be exceedingly desirable if the classes would in future establish the exact bearing of the lodes, which was not really east and west, although called so, but a few degrees north or south. It was most important that the precise bearing should be determined, so that they should be enabled by-and-bye to lay down a correct map of the mineral lodes of Cornwall. The ordinary compass bearings might be taken. He must tell the meeting that these notes were actually drawn up by the members of the respective classes of St. Day and Helston; which were the only ones in which field excursions had been organised. In his opinion, the sphere of these excursions would extend, and he was sure that they would be attended with the most beneficial results.

The Rev. SALTREN ROGERS read an extract from a record of the excursion to Carn Marth, which had been kept by an ordinary working miner, and which, as he truly remarked, showed that the practice of careful observation had not been confined to the more highly educated members of the classes.

MR. ROBERT HUNT then read the following paper :—  
ON THE SURFACE INDICATIONS OF MINERAL DEPOSITS.

(By a Member of the Helston Class.)

In a short paper, read at the last meeting of the association, a peculiar relation between the rich mineral deposits of the county and the surface formations was referred to as having been long observed by some mine agents, by whom it has been regarded to be of such importance as to afford, in connection with the relative direction of the veins and cleavage planes of the containing rock, reliable ground upon which to base an opinion as to the probable existence of ore deposits in any particular locality.

In the paper alluded to, it was stated that lodes are productive when the cleavage planes of the containing rock are at right angles to its direction ; that the cleavage planes are generally parallel to the more elevated portions of the surface ridges, and that the tops of the ore bunches are generally to be found in connection with the surface depressions branching from the main valleys, through which the springs of the district discharge their waters.

With a view of illustrating and endeavouring to draw attention to this subject, a copy of the Ordnance map of West Cornwall is submitted, upon which is marked the position of the outcrops, and direction of the dip of the ore deposits of such of the mines as precise information could be obtained of.

In Wheal Vor the outcrop was against the western cross-course, in the centre of the valley leading to Carleen, from whence the bunch dipped east at a considerable angle. At Wheal Metal the ore reached almost to surface, about a lead branch, in a depression about 400 fathoms east, the bunch being nearly perpendicular for nearly 150 fathoms, and then extending west. In Great Work, the ore from the surface on the head of the valley leading up from Herland village, dipped east ; and at the adjoining mines of Pollodrass Downs and Penhale, the indentations on the ridge mark the positions where the ore ground was shallow. The same feature is observable at Trewavas, and at Wheal Neptune, Wheal Charlotte, Trenow, and Tolvadden ; and at Botallack, the outcrop at the junction of several veins at the Crown Rock and the corresponding indentations of the cliff are evident. The same feature appears at Crenver, in Crowan ; in the Camborne mines, and at Wheal Buller, Penstruthal, and Tresavean ; in every case apparently so evident as to justify a conclusion that the existence of the mineral deposit and the erosion of the surface are assignable to a common cause. The absence of distortion in the subjacent rocks ; the character of the disintegration of the rock directly beneath the soil, and of the *débris* in the bottom ; their peculiar, well-defined, rounded terminations (so different to those in the Lizard promontory, where there are few springs and no proper lodes), and their frequent direction on the backs of cross-courses or in the direction of a channel of soft ground, point to local aqueous

agency as the principal, though gradual, means of the formation of the valleys. The generally received opinion among miners, that lodes are the water channels from which the springs of the district where they are situated are supplied, and that the cross-courses act as dams, preventing the free circulation of that liquid, taken in connection with the influence that these cross-courses are known to exert on the deposition of minerals in veins, afford presumptive evidence that water, acting through long periods, may (possibly by some action analogous to the dialysis of Professor Graham) gather, in solution, from the rocks through which it percolates, the mineral and quartzose portions, to be afterwards deposited by replacement (as illustrated by the pseudomorphs, to which attention has been called by Mr. Pearce) or some change of condition, or relief from pressure, in the fissure forming its receptacle, previous to its issuing forth as a spring. The peculiar situation of the cleavage planes about the productive portions of lodes; the change in the felspar of granite in the neighbourhood of mineral veins; the production of gossan and vitreous copper ore from the decomposition of yellow ore; and the continued discharge of mineral matters, in solution, from mines long after they have ceased working (as if to restore an equilibrium that had been disturbed by the penetration of the rocks); and the variable bearing of productive lodes, appear all to favour an hypothesis of this nature. Their consideration would occupy too much time to be entered on in a paper of this sort, the aim of which is to draw attention to the subject, which appears to the writer to be pregnant with interest.

Mr. HUNT observed that the subject was truly a most important one. There was one word used which he fancied would not be familiar to some of the persons present. He alluded to the word *dialysis*, which had been recently introduced into scientific nomenclature. It was used to express the peculiar phenomena which took place when there were fluids of dissimilar kinds on two sides of a porous wall. Supposing that a mixture of salt and water were put into a cylinder the bottom of which was formed of a diaphragm of bladder, and that cylinder was then placed in a vessel of water, in the course of some hours the salt would be found to have passed through the diaphragm into the outer vessel. In Glasgow there were extensive establishments for curing the meat required by vessels coming to that port. In the process of curing a large amount of the juices or albumen—the most valuable portion of the meat—was extracted, by the salt and left in the brine, and formerly this was allowed to run into the river Clyde. But now by the adoption of the principle of the dialysis, the salt was extracted from the brine, the albumen was preserved, and used for making soups, and thus thousands of pounds worth of most nutritious food which formerly was allowed to run to waste, was saved. Mr. Hunt explained how the same principle would operate with regard to mineral solutions by stating that if they placed on one side of such a diaphragm as he had described some

mineral water from any of the mines, and on the other side pure water, they would find that some of the salt in solution would pass into the water. He believed that this discovery would be found to play a very important part hereafter.

MR. R. PEARCE then read the following paper which had been prepared by himself, on

#### THE INFLUENCE OF LODES ON ROCKS.

A short time since, I read a paper at one of our meetings on the alteration of Granite in the vicinity of lodes. During the last few months I have had opportunities of observing a great many interesting facts connected with rock metamorphism which may not prove uninteresting to the members of the Association.

It is a fact well known to most miners that the granite which is found near lodes is frequently different, both in composition and general character, from the granite which is met with at some distance from the lodes. To be convinced of this fact, we have only to observe the granite in the quarries at the summit of Carn Marth, and compare it with a sample of rock from the base of the hill near Wheal Damsel. Many other districts in Cornwall offer fine examples of these rock changes. The conditions are not the same in every district; the various kinds of alterations being effected perhaps by local causes. If we observe carefully the joints in granite quarries, we find that the walls of these joints are often coated with crystals of schorl, and the felspar of the granite near the joints is sometimes replaced by this mineral, or much discoloured from the presence of oxide of iron; shewing that these small fissures are sufficient in many cases to produce a number of important changes both in the composition and general appearance of the granite. It is found, too, that the direction of the joints materially affects the characters of the mineralogical changes which take place; thus, for example, in the quarry at Carn Marth, the joints having a bearing about 25 deg. S. of W., contained amethyst, fluor spar and chlorite, whilst in those joints having a direction 10 deg. W. of N. nothing but schorl and oxide of iron could be detected. At Trelubbas quarry, Wendron, this was still more strikingly shown; the joints having a bearing 20 deg. S. of W. were found to contain chlorite, copper pyrites, white mudiic and blonde, while on the other hand those which had a contrary direction were perfectly free from those minerals, and contained nothing but schorl and oxide of iron. In the St. Just district precisely analogous conditions may be found. These mineralogical changes may be seen, however, on a much larger scale in granite and elvan when found in close proximity to mineral lodes. Take, for example, the mining districts of St. Just, St. Ives, Wendron, Redruth, Gwennap, and Liskeard, and we find that although there may be a difference in the mineralogical character of these changes, yet there is no difficulty in tracing their origin to the effect of mineral lodes. There is no

doubt but that similar changes may be found in our stratified rocks, but these do not offer the same advantages for observation as the crystalline rocks which I have named—granite and elvan.

One of the most common forms of these alterations is the change of one or more of the constituents of granite (feldspar, quartz, and mica) into chlorite; this may be observed in almost every metalliferous district in the county where granite occurs. The mineral which is most commonly metamorphosed is feldspar, as it appears to be less capable of resisting the solvent action of water than the other minerals, quartz and mica. It is not common, however, to find well formed pseudomorphs of chlorite after feldspar. I have observed them recently in the granite near Carn Marth, and also in an elvan course at the Consolidated Mines, Gwennap.

My attention was first directed to this elvan course by Mr. Enys, who had noticed some of its peculiar characters for a long time. It appears to have undergone a series of very interesting changes. The first alteration appears to be the conversion of the amorphous feldspar into quartz, leaving the crystalline feldspar intact; the next change is the substitution of the crystalline feldspar by chlorite. It is very evident that the crystalline feldspar is extremely liable to alteration, for we find that simple exposure to atmospheric influences is sufficient to cause it to disintegrate and change into kaolin or china clay. In one or two instances Mr. Saltren Rogers and myself have observed that the replacement of the feldspar by chlorite has commenced in the centre of the crystal. These changes may be seen in all their stages in the elvan rocks on the surface, at the afore mentioned mine. The replacement of feldspar in granite by chlorite is well shown in the mining districts of Gwennap, Camborne, and Redruth, St. Ives—and also in the Caradon Mines; and there are strong evidences of the formation of lodes by the alteration of the granite. I have seen tin lodes near St. Austell which consist of altered granite (schorl, quartz, mica, and oxide of tin). The tin lodes in many of the St. Just mines exhibit satisfactory proofs of having been formed by the metamorphism of the granite in which they occur. Examples of this kind may be seen also at Dolcoath and many other mines.

The above facts would lead us to believe that there is a relation between the natural joints of rocks and mineral lodes; for we have strong grounds for supposing that many of the lodes in Cornwall and elsewhere, have been formed by the infiltration of water (containing in solution the various minerals) through the natural joints, producing in its passage the changes which are seen. The discovery of copper and associated minerals at Tre-lubbas quarry in the joints having a direction 10 to 20 N. of E. and S. of W. (whilst those minerals were entirely absent in the joints running in a contrary direction) indicates that these minerals are deposited in the joints having about the same direction as the principal lodes of Cornwall. The lodes which are seen at Priest's Cove, St. Just, in the granite, have all been formed in the natural joints of that rock.

Schorl, fluor spar, oxide of tin, and iron pyrites, are found sometimes replacing one or more of the ordinary constituents of granite and elvan. Pseudomorphs of oxide of tin after felspar have been met with in the elvan course at Wheal Coates (St. Agnes), and in the granite at Balleswidden Mine, St. Just; it has been found replacing the felspar in the granite near the foot wall of the lode at Phoenix, and also at Dolcoath, but in this instance the quartz of the granite has been substituted by this mineral.

The replacement of felspar by schorl is of very common occurrence; it is not only seen in districts where mineral lodes abound, but occurs frequently at the junction of the granite with the slate. On the north side of Cape Cornwall, where these rocks join, may be seen huge blocks of granite, the felspar of which has been, partly, and sometimes entirely replaced by schorl; the same change may be seen at St. Ives, and also in the parish of St. Enoder. At the latter place perfect pseudomorphs of schorl after felspar may be found; the felspar has been converted into china clay, which occurs in large quantities in the district. I have observed some interesting pseudomorphs of schorl after felspar in an elvan course at Poldice. The presence of iron pyrites in granite is of great interest. I have observed it recently in the Wendron district, near Wheal Trumpet and Old Wheal Mount mines; the mundic occurs in isolated cubes diffused equally throughout the rock, but only in close proximity to the lodes.

I think we must either ascribe the existence of this mineral in the granite to the influence of the lodes passing through it, producing this metamorphism, or discard the theory of its igneous origin; because it is well known that bi-sulphide of iron (iron pyrites) cannot exist at the temperature of fused granite. From the peculiar character of the rock, and its relation to the lodes, I should certainly be inclined to adopt the former opinion. The crystals of mundic, on exposure to the atmosphere, become converted into pseudomorphs of red oxide of iron.

It is difficult to account for the various changes which I have named. It is, however, evident that water plays the chief part; and probably the substances produced by the destruction of one mineral, re-unite to form the mineral which takes its place. If we compare the chemical composition of felspar with chlorite, we find that the only difference is, the substitution of potash and a portion of the silica of the felspar, by magnesia, oxide of iron and water. We find that the water which circulates through the fissures and joints of rocks frequently contains both these substances, oxide of iron and magnesia) in solution, and we also know that felspar is a mineral which under certain circumstances is readily decomposed, yielding up its potash, so that there is little difficulty in accounting for the change of felspar into chlorite; heat would also very materially assist in bringing about these changes. At the Clifford Mines, Gwennap, where we find the elvan metamorphism so well shown, the temperature of the water coming from the lode is very high (it registered a few months since 125 degs). This, I have no doubt,

accounts in a great measure for the rapid decay and repair to which the rock has been subjected. I have every reason to believe (after a number of careful observations) that the *capel* of lodes has been formed from the products of the decay of minerals which enter into the composition of the rocks adjoining. A number of careful analyses of capel from districts would, I have no doubt, greatly assist in explaining this point.

The facts which I have noticed in this paper may appear to have little practical bearing in a mining point of view. I am convinced, however, that the subject is an important one, and if diligently investigated, must assist in explaining some of the laws which regulate mineral deposits.

On the table were a number of illustrative specimens gathered from different places, which Mr. Pearce said he should have much pleasure in further explaining to any of the company at the termination of the meeting.

After a few words from Lieut. Rogers and Mr. Enys, in confirmation of one or two of the facts which had been cited by Mr. Pearce,

#### ON BLASTING IN MINES.

Capt. WILLIAMS, of the Charlestown mines, said that in his opinion the association ought not to restrict its labours solely to the teaching of mineralogy, but should deal also with those operations which affected the life and health of the working miner. For instance, they saw that a great number of accidents occurred in mines from blasting, and he thought that if the association was to take into consideration the causes of these accidents, and to ask the agents of the various mines in the county to furnish information on the subject, they might by the dissemination of the information thus obtained, be able to diminish the number of these sad occurrences. He had been lately employed by the Mines' Commission to witness the effects of the explosion of gun cotton in Dolcoath mines, and he had also been led to consider the subject of accidents from blasting in the mines which were under his own control. This had led to the adoption of certain precautions which had been attended with most gratifying results. During the eight months prior to the 31st of August last, 25,200 holes had been fired in the Charlestown mines; and only two premature explosions and accidents had occurred, although they used ordinary blasting powder. One man had been injured by an accident which occurred from using, against the rules, naked powder. The other accident had occurred a week or two since, and it was expected that the man would be at work again in a month. They invariably used the tamping bar which was common in Cornwall, but he thought that when he explained the regulations which were enforced in blasting, it would be seen that the adoption of these was the cause of so few accidents occurring.

The rules were as follows :—

- 1st. No powder cans are to be left in any part of the back, stopa, end, or sink, without the top is properly put on the same; and the top of a powder-can, in use, is not to be used for any other purpose than stopping the can.—2nd. No naked powder is to be placed in any hole, in any case; but

must be put in a paper or cauvass bag or cartridge.—3rd. No safety fuse to be cut after being inserted in the cartridge, or bag, or hole; but must be cut off before being inserted in the powder.—4th. In every case, after the cartridge has been put into the hole, a wadding of shagg or wool must be gently pressed down on the charge, and no other material will be allowed to be placed on the bag or cartridge immediately on the powder.—5th. No tamping bars are to be used or had in the ends, backs, stopes, or sinks, or in any part of the mine, but those delivered at the account house with copper ends.—6th. Should the copper flooring of the tamping bar come off, the same to be returned, and a new one will be delivered for the same.—7th. Any departure from the foregoing rules, by any person or persons employed in these mines, will cause their discharge from these mines without any notice; and any monies due to them from these mines will be forfeited to the adventurers.

Capt. WILLIAMS added that to the operation of these rules at Charlestown mines he attributed the freedom from danger which had attended the blasting operations at that large concern, which employed about 1000 men, and he thought the Association would do well to consider the subject, for the benefit of the mining community at large. He handed in specimens of the tamping bars and of the wadding used.

The CHAIRMAN—Do you find any objection raised to these rules by men on their first coming to work at the mines?

Capt. WILLIAMS—None; they are posted up in the counting house, and their attention is called to them as the rules that are in force in underground blasting.

Mr. W. M. GRYLLS—Are the rules always practically carried into effect by the miners? Capt. WILLIAMS—Invariably.

Mr. HUNT said that the necessity of the Association's directing its attention to matters connected with the welfare of the working miner was admitted by all. Nothing, in fact, came more within the scope of a Miners' Association, and they should assuredly do all that they could to ameliorate the condition of the working miner, and to protect him against those hazards which naturally attended upon his work. Still, up to the present time the Association had not felt itself in the happy position of being able to extend its operations in that direction. In the course, however, of a few weeks the report of the Mines' Commission would be issued, and in the evidence in the appendix therein contained, they would find, he thought, the largest possible amount of information with regard to all the conditions of accidents arising from the use of gunpowder in mines. When they had that evidence, they might be enabled to frame some rules which would meet the conditions to which Capt. Williams pointed.

On the motion of Mr. GRYLLS, seconded by Mr. ENYS, the statement made by Capt. Williams, and the rules produced by him, were ordered to be entered on the records of the Association, and printed.

## ON EXAMINATIONS IN SCIENCE.

The Rev. SALTREN ROGERS then read the following paper, contributed by himself :—

It has for some time been felt that a healthy impetus might be given to the classes under our lecturer's instruction, if examinations could be conducted from time to time, and some mark of distinction, a prize or a certificate of attainment, awarded to such as had acquitted themselves well.

My object in now addressing you is not to lay before you any organised system of examination already prepared, but rather to call attention to the subject, and promote such discussion as may lead to a determination of the principles on which such examination may be held.

It has been suggested by some that it would be desirable to grant a diploma or certificate of attainment up to a fixed standard, to all such as should exhibit a sufficient amount of knowledge.

It may be questioned whether we are in a position at present to grant such diploma. It would be a delicate matter to avoid, on the one hand, a standard so high as to discourage men from going in for the year, on account of the numbers that failed; and on the other, to avoid a standard so low as to be readily attainable by men whose training had not been such as to secure to them a fair chance of success, thus bringing the diploma into contempt.

At all events, it would seem desirable, at least, to defer such a course for the present; and, if after testing for some few years the strength of our candidates, and after having gained some experience in examining them, we could feel our way to offering a certificate of attainment, it might be then considered again.

The following are subjects on their lists of examination papers, which would more or less harmonise with the objects of our Miners' Association :—

1. Mining.
2. Mineralogy.
3. Geology.
4. Applied Mechanics.
5. Theoretical.
6. Mechanical and Machine Drawing.
7. Practical Plane Geometry.
8. Navigation. Steam.
9. Ditto. Mathematics—1 paper.
10. Ditto. Ditto—2 papers.

As to the other course of holding competitive examinations in which the prizes or honors should be awarded, not in consideration of a certain standard of attainment, but simply to the best out of such as might compete, it would be for us to remember that there is already established a system of examination under the Department of Science and Art at South Kensington, which has been growing rapidly throughout the kingdom, but which, it is to be regretted, has as yet gained but little footing in Cornwall and Devon.

Probably it would be our better course to encourage our pupils to offer themselves as candidates for these examinations, and either keeping them as the only examination, work up our pupils with a view to them ; or else organise our own separate examinations with reference to them, as supplementary.

If we take the latter course, we must hold our examinations not (I would suggest) at one central point, but (for the convenience of the candidates) simultaneously in the locality of each class or group of candidates. They should be held at a time not too near that of the South Kensington examination ; before, as preparatory to them, rather than after. Not earlier than the end of December, because the autumn will probably be found, in practise, a better working season than the summer. Not later than the end of February, so that two months may elapse before the government examinations, as a period in which promising pupils may be pushed on, and lagging pupils have their weak points strengthened, to ensure greater success.

One point of some delicacy, which will require some care and judgment, is that of setting the questions. Care must be taken to anticipate the fear of jealousies arising between class and class, and to give confidence in strict impartiality. And yet the person or persons setting the questions should be acquainted with the attainments of the candidates in general, and the nature of the instruction which has been given to them.

And then, again, great care should be taken to make the questions easy and simple at first sight, so as to encourage candidates to try. This may be done (it appears to me) without lowering the standard, and without excluding such questions as would draw out the deeper knowledge of the more advanced candidates. Those questions are the best for such an examination as can be answered in some degree by most of the candidates, but which admit of many degrees of excellence in the mode of answering.

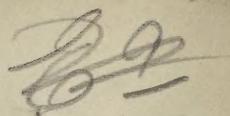
The South Kensington questions in mineralogy, for the examination of last spring, appear to me hardly adapted to our pupils in this respect. They bore so much on crystallography, the most abstruse and least practical branch of the subject, especially in the former half of the sheet, as to frighten the candidates, at first sight, into a depressing sense of their ignorance, which hardly gave them a fair chance of showing what they knew in the other branches of the subject.

Another question to be considered is, whether it would be feasible to connect the examination scheme with the Polytechnic Society, and in what manner their co-operation might be invited.

Having thus ventured a few remarks, by way of inviting your attention to the subject, I gladly leave it in the hands of those around me, whose sound sense and practical experience will enable them to judge whether any such prize scheme would be desirable, and if so, in what way it would be best carried out.

This being the last paper,

Mr. HUNT, after some remarks on the importance of the subject introduced by Mr. Rogers, proceeded to give some particulars relative to the position and progress of the Association during the past year. They had lost one of their teachers, and not being able to replace him, they had been labouring under some difficulty, as it was utterly impossible that one teacher, however indefatigable, could carry on the work. Their classes had now been organised from Tavistock down to St. Just, and it was quite impossible that one man could traverse the whole of this district and give lectures in any great number of places. They had embraced within their operations during the past year Tavistock, Gunnislake, Wendron, Helston, and St. Just, with one or two other places. There was one point connected with the working of the association upon which it was necessary that a very decided answer should be given. He alluded to the impression which prevailed amongst many of the intelligent miners that the classes of the Miners' Association dealt with theoretical views rather than practical science—that was that the classes rather dealt with speculations than with facts. Now, a most decided negative should at once be given to any impression of that kind; for so far from its being true, he would undertake to show that by far the most practical miners would be found to be those who studied in the classes of the Miners' Association. The theoretical man was generally the ignorant man; and the practical man was invariably the man who had the most knowledge. Hence the talk which they heard about practical and theoretical was in nine cases out of ten a mistake. It was not for a moment intended that the classes of the Miners' Association should teach mining. No one had ever dreamt that either the Royal School of Mines in London, or that the mining classes in St. Just, Tavistock, or Gunnislake, or of any other place, would make a man a miner. A man could only be made a miner by working with his own hands in the subterranean recesses of the mines; but they might make a man a far better miner by instructing him in those branches of science which would lighten his labours. All science aided not only in the discovery of the truth, but in the application of that truth to the amelioration of the necessities of man's existence. A miner laboured under enormous difficulties in plying his vocation. There was no man that was subject to a larger amount of casualties, or who required to exercise greater care than the miner; and the knowledge of certain branches of science would enable him to correct those errors which rendered him liable to those serious casualties which now so often occurred. He would not go into detail of the various points in which scientific information would prove advantageous to the miner; but he would observe how important it was that the working miner should have some little knowledge of the laws which regulated the circulation of air, so as to be able to protect himself from the evils which continually arose from foul ends; how important it was that the miner should be acquainted with those very simple laws which regulated the pressure and flow of water; how it was of the



highest importance to him that he should have a knowledge of the principles of mechanical science. A knowledge of the laws of the simple mechanical powers—the lever, the wedge, the inclined plane—it was true he would gain by experience; but how much more readily he would acquire such information by giving his attention to that knowledge which was gathered in the works of the foremost men that had ever existed during a long series of ages. Then, again, with regard to such sciences as geology, mineralogy, and chemistry, how important it was that some knowledge of them should be possessed by the working miner. They were continually having evidence of the necessity of this. It was only within the last fortnight that he had had placed in his hands a large piece of mineral, which had been brought from abroad by a miner, who considered it the finest bit of tin that he had ever seen. He did not believe that there was the slightest particle of tin about the stone, which was in fact a mass of wolfram. Many other instances might be mentioned to enforce the necessity of the miner possessing a knowledge of the laws by which they were enabled to distinguish one kind of mineral from another. Such information was to be gained by attending the classes of the Miners' Association, the education in which, he must again impress upon his hearers, was not in any way theoretical. It was their earnest desire, on the contrary, that it should be thoroughly practical; the one object being to take the young miner as he was working underground, and to give him in the hours he could spare for the purpose that information which would tend to increase his capacity of receiving knowledge and to improve his powers of observation. This good work was done by the Miners' Association, and he believed that the result would be that they would have a far better class of practical miners. (Applause.)

The CHAIRMAN thought that the proceedings would have satisfied every person who had been present that the association was not standing still, but that it was steadily accomplishing the object for which it was established. He trusted that all those who were more immediately interested in the welfare of the miner, and especially the landowners of the county, would come forward and give to the Association their hearty support, as he felt assured this was all that was wanted to secure the attainment of the important results which Mr. Robert Hunt and others had in view on its establishment.

On the motion of Mr. W. M. GRYLLS, seconded by Capt. WILLIAMS, the thanks of the meeting were accorded to the Chairman, and that gentleman having acknowledged the compliment, the proceedings terminated.

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